Development of Mobile Welding Robot Motion Software for Large-Scale Environment Welding

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● Introduction

An LNG cargo tank is a vast room occupying most of the LNG carriers. The size of it is usually enormous, reaching 20M or more in height, 20M in width or more, and 30M or more in depth. This large LNG cargo tank is manufactured by welding the membrane module. The size of membranes varies. On average, it is 3,000mm wide and 1,000mm long. Since roughly 2,000 membranes are used in one LNG cargo tank, it takes several months to produce. This study introduces the development of mobile welding robot motion decision software for welding large-scale targets.
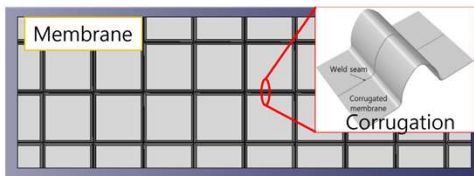

Fig. LNG Cargo Tank and Membrane.
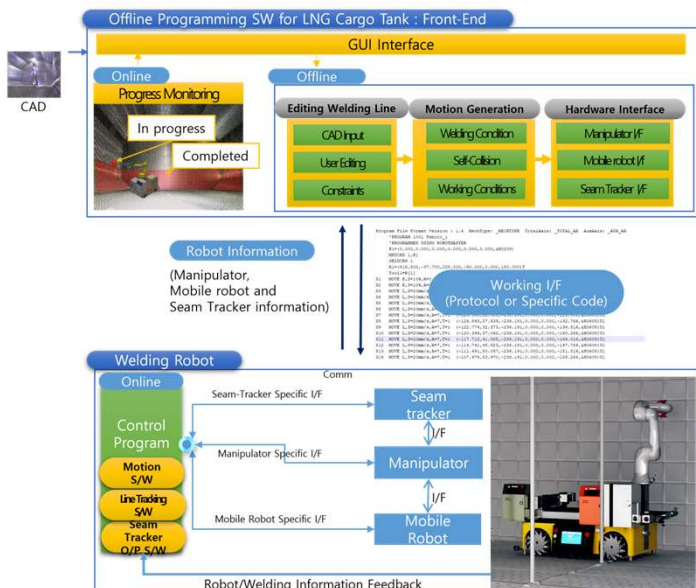
● Development of SW for LSRW

Fig. Developed SW Structrue

What differentiates the developed product from the existing offline programming software is that the target robot is a mobile manipulator, and the work area is huge. The developed software reads the CAD of the work target and identifies the membranes. For the identified membranes, there is a predefined DB, and detailed operations for welding the four sides of the membrane are written in the DB.
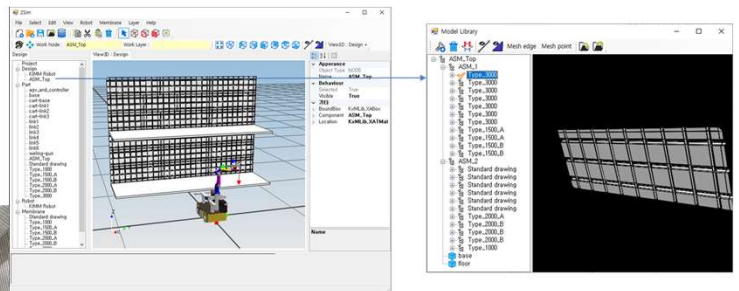

Fig. Understanding the target environment

Ex) Type_3000.xml

```xml
<?xml version="1.0" standalone="yes"?>
<MembraneFile>
  <Version>1</Version>
  <Type> Type_3000 </Type>
  <Shape> Type_3000.part </Shape>
  <WeldLines>
    <Left>
      <Location X="0" Y="0" Z="0" NX="0" NY="0" Nz="0"/>
      ....
      <Location X="0" Y="0" Z="0" NX="0" NY="0" Nz="0"/>
    </Left>
    <Right> ... </Right>
    <Bottom> .. </Bottom>
    <Top> ... </Top>
  </WeldLines>
</MembraneFile>
```
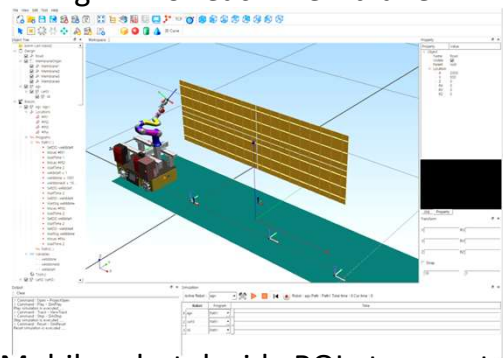
Fig. DB for each membrane

Fig. Mobile robot decide ROI at current position.

After moving, the mobile welding robot determines the workable area with a predefined length at the stop position and adds the membrane within the area to the work target list. The robot's work order is determined through an optimal path generation algorithm for the added membranes.

● Conclusion

Mobile robot motion determination software for automatic welding of LNG cargo, which is a large-scale welding target, has been developed.